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The Control of Evolution in Man*

CHAIRMAN: Professor David Glass: You have no doubt already seen a good number of reports on the celebrations of the Darwin centenary. There has been at least one book already and there will certainly be many more books and articles on the subject.

Darwin himself surveyed the whole field of evolution but since Darwin's day work has proceeded in rather specific fields of evolution. In particular, in the human field the whole study of human genetics is of relatively recent development and in the last twenty or thirty years great strides have been made in this study. I wonder whether now we ought not to pay special attention to the human aspect of evolution, whether we ought not to look at what have been the contributions in the last fifty years or so and how far these would enable us to say something more about man and his evolution and his prospects for the future than has been said—in a general way, at least—by many people in the past. Darlington, I wonder whether you would mind beginning by saying something about man's evolution—what is the history of man in genetic terms, and what are his prospects.

Professor C. D. Darlington: Well, I suppose the two important ideas that Darwin introduced to the world at large were the ideas that man can be considered as an animal and that his peculiarly human characteristics have arisen during his evolution from an animal. And that means, of course, that when we consider his physical properties on the one hand, and on the other hand all his mental characteristics, they are all capable of being understood in the first instance by analogy with what we observe in animals, and particularly by the study of human heredity and human variation: natural selection, sexual selection, geographical isolation and all these ideas. And I think there are two very important advances that genetics has made in studying these ideas. They are the understanding of the importance for evolution of the systems of inbreeding and outbreeding that occur in plants and in animals and in man. In man they have been developed to an extraordinary extent, and in some respects a unique extent, by his own intelligence. As he has grown more and more intelligent he has become more and more discriminating in his choice of his mate.

Glass: May I interrupt you here? How do you mean that he's become more discriminating—what kind of discrimination?

Darlington: I mean that he has avoided breeding with his relatively near neighbours by a principle of what is called exogamy, outbreeding, and at the same time, of course, he has developed a very fine discrimination in regard to the avoidance of inbreeding: in nearly all civilized and uncivilized societies he specifically avoids inbreeding with members of his own family. And those two conditions are, on the grounds of genetics, likely to be extraordinarily important in determining evolutionary processes.

Glass: Waddington, do you think these are the two most important aspects?

Professor C. H. Waddington: I feel that in man we have to take into account the fact that

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he has produced a second way of transmitting things from one generation to the next—he has a second system, which is the system of social teaching and learning—transmission through books or writing or speaking. This is extremely rapid compared to the biological system. And if one is thinking in terms of a few generations—a century, or times of that order—my own feeling is that this second human mechanism is the one which really decides things in the short-term. It's based, I think, as Darlington has said, on a long-term biological animal background mechanism. But to a considerable extent the short-term overshadows the biological mechanism, in my view. So that in considering questions of breeding between different classes, between different races—if we're thinking in terms of only a hundred years—I believe the social factors are probably more important than the animal genetical ones.

Glass: I wonder—now, I'd like to take up this question with Darlington; it derives from what you said, Waddington—whether you don't think that the social factors themselves have not in a sense revolutionized the biological factors in, say, the last hundred years. Haven't the social factors changed so much since, say, the middle of the nineteenth century that breeding habits are radically different now from what they were a hundred years ago.

Darlington: Oh, no, I absolutely disagree. I think the social discrimination in breeding is as strong now as it ever was; the genetic differentiation—the social classes in England—is probably increasing in intensity. It's increasing as a result of education, that is to say, ability is being drawn out of the working-class into the middle-classes, and out of the middle-classes into the governing-class, and those classes are becoming probably more differentiated than they ever have been before.

Glass: Do you agree with that, Waddington?

Waddington: I should say it's questionable whether some classes or other are becoming more sharply distinguished. But if they are, they're not the same classes as were being distinguished a hundred years ago.

Darlington: No. Evolution is taking place.

Waddington: But evolution of the mechanism is also taking place. A hundred years ago, say, we had classes defined in ways originally based on the ownership of land or on the accumulation of capital. Now, from what you're saying yourself, if we have classes they are going to be much more determined by intellectual ability as exhibited in school tests.

Glass: More and more assortative mating—for example, in terms of educational background——

Waddington: Well it was assortative mating in the days when the landed gentry married the landed gentry. Now it may be assortative mating on the basis that people with a high I.Q. marry each other or the class structure will be based on the eleven-plus exam——

Glass: The grammar-school boy marrying the grammar-school girl.

Darlington: Oh, I'm glad you both agree there is assortative mating and that that is going to have a very important effect because it means that society is in genetically differentiated groups —differentiated in their abilities so far as they can be tested by all the mechanisms of schools and universities——

Waddington: May I burst in on——?

Glass: Do. I can see that you don't really agree with this.

Waddington: If it went on for tens of generations without any change it would have important effects on the biological level by selection of certain hereditary characters, and so on. It's very unlikely to go on—it's only gone on for two generations since we invented the I.Q. system or whatever it is, or not even that—one generation——

Glass: One half of one generation——

Waddington: It will have important effects, but not biological ones—it will have important effects through the sociological and not biological transmission of characters within families.

Darlington: But do you think that the people who pass an examination and the people who don't pass it are genetically not to be distinguished?

Glass: It would be a little difficult to be hard and fast as to whether those who pass the eleven-plus exam or those who don't are biologically distinct. But quite apart from that, you seem to have forgotten, Professor Darlington, the whole question of the breaking up of terri-

torial assortative mating, the fact that people in villages married each other a hundred years ago and that now the area in which they choose a mate has been greatly increased. I've heard it said, for example, by geneticists, that the motor-bicycle has been the greatest reshuffler of genes the world has ever known! This is not the same assortative mating—this is a sort of alternative to the earlier assortative mating. How does this fit in with your scheme?

Darlington: Oh, I don't agree with you that it's not assortative—I think it is still assortative: I think that it's more assortative now than it was unfortunately before because now we have less illegitimacy in this country than ever before, and illegitimacy, of course, was the only means that existed for a real breakdown of assortative mating in former days. It produced, of course, very important and valuable results. But all these changes in the system of assortative mating are themselves bound to give rise to genetic changes —genetic changes in class structure, and evolutionary changes.

Waddington: Well, again you are thinking in terms of tens of generations—they are bound, if they go on long enough, to give changes of a biological nature, but if they go on quite a short time—two or three generations—they may give rise to changes, but they will be changes on the sociological level, due to the transmission of family traditions in the family, and so on, rather than of biological factors.

Glass: Yes, I should think that human breeding habits are habits which may change fairly radically over the short run—I mean, the fact, for example, at the present time that the age of marriage is probably lower than it's been for the last three hundred years is an important sociological phenomenon, rather than a biological——

Darlington: Not so important as the genetic one—it has no consequences, therefore, in evolution. It's not a question, surely, of what will happen in two hundred years—we are discussing evolution. In a thousand years, the British system of class structure of society has developed—in thirty generations—and that is an evolutionary change which has happened in the past, and it is very likely, therefore, that similar changes will happen in the future.

Waddington: But the American system of class structure, which is as definite—[No]—or perhaps not quite as definite as the British. They pretend it isn't, but it's jolly nearly as definite as the British—has developed in two or three generations in an immigrant population, presumably of violently different heredity—but it's been developed, not on a basis of hereditary differences, but of social differences.

Darlington: The American system of class differentiation has developed in precisely three hundred and fifty years, as a result of genetic differences amongst the people who arrived in America originally and have been arriving ever since.

Glass: Well, I think there is a very wide margin of disagreement—not only between you and me on this subject but between the three of us and many other people. I wonder whether, even so, we could go on to another question, which is really very relevant to the discussion here—namely: taking this general background of man's own evolution, how far in the past have there been deliberate efforts to control it? How far has man, with what intelligence he has, tried —either on the basis of actual knowledge or assumed knowledge—deliberately to alter breeding habits in order to create particular types of human being or of human groups, Professor Darlington: what do you think?

Darlington: Well, I feel the most important evidence we have is, first of all with regard to the origin of caste in India, and secondly with regard to the origin of social structure in Greece and Rome in early historic times, and the evidence is, I believe, that in both these cases there has been a strict rejection of breeding between what we should call social classes; this rejection of breeding between social classes has of course, never been a hundred per cent effective, but as far as it has been effective, it has kept those classes in a character for—usually—three or four hundred years, sometimes, in the case of India, for much longer periods—kept them in a character which has given them a special social value. The distinction between the Brahmins, for example, and other castes in India is very obvious; the distinction between the patricians and the plebs in Rome was very marked, and led to the most bitter revolutions, and exactly the

same kind of distinctions have been described in more primitive cultures. All those systems of restrictions of mating have a profound evolutionary effect, because if we all mated at random it's perfectly certain, on our knowledge of animal genetics, that the results of breeding would be quite different.

Glass: Yes, but you yourself have said that the system of breeding within the patrician category in Rome gave rise to great unrest—it gave rise to revolutions; it gave rise to a reshuffling of the breeding systems. Aren't you over-simplying the history of man in saying that these breeding systems have been so consistent and so self-contained: Waddington, what do you think about this claim?

Waddington: In the majority of cases, I think that these distinctions between classes that don't marry each other, or castes that don't marry each other, are probably primarily sociological and transmitted by sociology. If we all married at random and if, in a caste system, everyone married across the castes, of course the caste system would break down, because you would be bringing wives of one caste into a father's house of a different caste, and the family traditions would break down—and I think that that is much more generally important in the historical periods when we think in terms of one or two centuries. Again, I feel all the time we are talking about evolution in man and, for the biologist, evolution is something that takes place in fifty thousand years, or more.

Darlington: That's what I've been saying, you see—that you have no right to say that evolution proceeds slowly in man because it proceeds slowly in animals, and in my opinion it's quite the reverse—man's evolution is proceeding rapidly——

Waddington: It's proceeding rapidly because of the social mechanism, not because of the biological mechanism.

Glass: Yes, but if these breeding systems are continuously interrupted—is there really any kind of class system which is completely endogamous or even so endogamous in the general sense as to be really an inbred system? Every class system, even an Estate system accepts people from below. It may take a generation, but they do move up.

Darlington: It took far more than a generation in Rome to introduce the Plebs.

Waddington: The old statement in Britain in the last century: it took three generations to make a gentleman, wasn't it? That was when we had a definite class system in which "gentleman" was a definite position in the class structure. If you could make a gentleman in three generations, you could do very little genetically in three generations. A cattle-breeder, with absolute control over breeding, may be able to make some difference in three generations, but in an ordinary society, where mating is by personal choice, three generations is a negligible time genetically. If you've changed a lower-class into a gentleman in three generations—you've changed him socially, but not genetically.

Glass: Yes, and I think you exaggerate the time-scale, for the great role of the public school in the nineteenth century was to make a gentleman in one generation.

Darlington: Yes, but a man couldn't get into a public school—a working-man get into a public school—by saying "I wish to go into a public school"—he couldn't. His parents had to have money. His parents had therefore to have had a definite character distinct from the other people; other members of the class from which they arose. Now those classes, with those distinctions, I'm not saying that they were good or bad but they were different. They may have been outstanding gangsters; undoubtedly some were, but they were different and——

Waddington: Different socially.

Darlington: Genetically, certainly genetically.

Glass: Well, that's exactly the problem—at this point we are unable to distinguish the relative weight of the genetic and the social components.

Waddington: I think really I ought to say here that I have been acting a bit as the Devil's Advocate on the social side and Darlington—I doubt whether he would admit to it—acting as the Devil's Advocate on the genetical side. My personal feeling is that really we don't know.

Darlington: You think you can make a silk purse out of a sow's ear then? With a little care?

Waddington: In man I think you can.

Glass: I'm afraid we must leave that point here. We haven't really said a great deal about the deliberate control of man's evolution in the

past. We haven't, for example, mentioned the kind of schemes of so-called race control which were put into force or which were attempted in various regimes of the past, like those of the Nazis, for example. But perhaps we'd better leave those topics now and reconsider our present situation. Here we are with all of this new work on human genetics. Knowing what we do know at the present time about human genetics, what kind of basis do we have for making suggestions for measures of political policy—either positive measures, or negative measures, of giving advice to people to discourage them or introducing measures to encourage them to have children. Professor Darlington, what do you think?

Darlington: Well, I don't think we know very much more in human genetics than was known by Galton seventy years ago when he first investigated these problems and I think what Galton would have said, and what I certainly am prepared to say, is that every important administrative act of governments affects the evolutionary prospects of the people they govern; education affects the migration of people from one social class to another. It affects, in fact, the kind of social classes you have. The Welfare State, by introducing medicine to the whole nation affects the survival of individuals who would not otherwise survive and consequently their propagation. Family allowances favour one race against another and they also favour one class against another and the way in which you administer them will therefore have evolutionary effects. Imprisonment affects the reproductive capacities of the people who are imprisoned, it effects the propagation of the criminal class for example, which is so noticeable at the present day. The control of migration affects of course the distribution of different kinds of people in different countries because migration is always selective. That is to say the less intelligent people stay cultivating the worse land and the more intelligent people always move on to the better land. That kind of principle has been operating in the past and it can be controlled and is controlled now by different kinds of administrative action. And finally of course you come to the question of artificial insemination.

Glass: May I just take up that point? You have been talking about the unconsidered, the unanticipated consequences of various kinds of administrative action and of course this is the kind of problem which occurs in every field. There are the unanticipated demographic consequences of social action and the unanticipated social consequences of economic activity and so on. But what about deliberate action? What do you think, Waddington, about our knowledge of human genetics to-day? How far would it enable us, for example, to make suggestions about negative eugenics? How far should we be justified scientifically in saying to given prospective parents for example, that they should or they should not have families or they should not have large families? Are we in a position to give sound advice of that kind at the present time?

Waddington: I think in certain situations we are. We know something about the heredity of certain definite conditions, diabetes for instance. We know something about the genetics of quite a number of human characters and I think we probably should provide a service by which parents could discover what the scientific information is about any transmissible, biological character they may have. My personal view is that it should then be entirely a matter for them to decide what they do about the information, whether this information is such that they would prefer not to have children or whether in spite of it they would rather go ahead and have them. But I really think this whole problem ought to be considered, not in a parochial sense of what we are doing to the population of Great Britain and its future. The major problems of the world to-day, it seems to me, are the problems of the relations between races throughout the whole world. And the major genetical problem facing mankind is the question of relations between Africans, Indians, Chinese, Western Europeans and so on. I feel that this problem should not be left out in any consideration of human evolution.

Glass: But if we do turn to that problem, if we cease to be parochial, how much do we really know on that more general problem?

Waddington: I'm afraid that's what I was going to say, we know remarkably little.

Darlington: I think we do know something

very important, we have every kind of evidence that all class structure in all civilized nations is the result of the mingling without inter-breeding of genetically different groups, sometimes, of course, different races. And that it is by the co-operation of different races which have now become different social classes that society has in fact developed to its present level, so that I think there is in history, in the genetic history of mankind, the most powerful evidence in favour of the understanding of genetics and the genetic interpretation of our social history.

Waddington: There are many cases, certainly, where one country, one nation, or one race, has conquered another and set itself up as the aristocracy and the other nation has been a lower class and then when they started to co-operate the whole society has done very well. I don't think there is any evidence that the class that happens in one case to have been conquered by the other is in any sense inferior.

Darlington: Why say *inferior*? The whole idea of inferiority it seems to me is a wrong notion to bring into this discussion. We are not concerned with inferiority when we talk about the co-operation in one society of different groups, each being necessary to the other.

Waddington: My saying that doesn't necessarily mean that they are inherently inferior at all.

Glass: I'd like to come back to one other point about which Darlington has talked. He was talking about the unanticipated consequences of administrative action—not only of explicitly administrative but also of general historical action—of uncontrolled historical action. I wonder whether some of this action has quite the same genetic consequences as it had say fifty or a hundred or two hundred years ago. For example, you mentioned the selective aspects of migration. Well, if you remember the inquiry conducted by the Scottish Council for Research in Education, they found that although there was evidence of selection in internal migration in Scotland, the I.Q. differences between people who moved and those who did not move were statistically very small. May it not be the case that when you build up to something more than a rather parochial system, you are in fact absorbing people so much in a wider society that some of the differences, the genetic differences that you emphasized as existing in the past, do not play the same role as they did a hundred years ago?

Darlington: Oh I think they do and I think they always have done. I would go much further than I have done and say that the whole difference in temperamental character between the peoples, for example, of the New World, people of the United States in particular, and those of Europe is that you have the difference between people who are genetically more restless, more energetic, in some ways, than the people of Europe and it is to that they owe their peculiar character.

Glass: I think that there will be a great deal of dispute on what you have said.

Waddington: I should hesitate to accept it; I feel that we probably don't know. There are so many other factors that could account for this restlessness. For example when they got to America it was an empty continent to all intents and purposes.

Glass: I'd go further than that. I'd say one of the great unifying and distinguishing characteristics of the American population, whatever their origin, is their attitude to political philosophy—that in this attitude they forget their origins and their historical experience and tend to adopt a single-minded approach to the nature of society. This is one aspect—and not a biological one—of creating a new society. However, apart from these historical developments and the unanticipated consequences of administrative action, what about direct action? For example there's a great deal of discussion and a certain amount of recourse to artificial insemination at the present time. How far is this likely to affect human evolution in the societies which are practising it?

Waddington: In my view it's not likely to affect it very much. Artificial insemination can be very effective in changing the genetical situation in a population if you use it in the sense of using one sire for a large number of cows as in artificial insemination of cattle. There you spread the heredity of one selected male over a large number of females and you can make considerable change in four, five or six generations. In human situations, there is no particular reason or even likelihood that a father in artificial

insemination by donor will be genetically very unlike the person the woman might have married in any case.

Glass: And it is most unlikely that there would be one sire for many wives. This would in fact be the great argument against using artificial insemination at all. I mean, on moral grounds wouldn't it?

Darlington: Well, if you're assuming that artificial insemination is going to be used on a very small scale, obviously, of course, artificial insemination doesn't matter very much. But it could be used on a large scale. It might be used on a large scale and the important thing is to discover from artificial insemination what its own results are likely to be. It so happens that artificial insemination is the only method of breeding in man which corresponds with the method of experimental breeding in animals. That is to say that you can know the results—in the terms of large families—of the breeding of a particular individual and it's going to be a very unfortunate thing if artificial insemination is carried out by people who don't understand human genetics, and don't record, and don't make available for anyone who does understand human genetics, the results of their operations: artificial insemination, if it is secret, could be most deleterious.

Glass: What you're arguing is that, whatever else is done, there should be statistical records. These records would not identify an individual or the progeny of a particular father, but they would be statistical and genetic records which would enable us to see what happens as a result of particular types of breeding.

Darlington: Yes, certainly.

Waddington: Yes, I think that it is certainly a potential source of a great deal of information about the human biological make-up, which it would be a great pity to lose.

Glass: Are there any other forms of deliberate control of evolution which you think are relevant, but which, for example, might not be accepted by the kind of society in which we live, or to which we aspire?

Waddington: I think the great problem in this connection is the problem of the numbers of human beings in the world. I think there are too many people in this country, and I think that the population seems to be growing much too fast in almost all countries. It's possible that we can keep pace with it, with our reproduction rate, by the full application of science to agriculture, producing foodstuffs and so on. I think it's unlikely we shall, in point of fact—I think we shall have enormous population pressures—famines, or half-famines, and so on. But I think one of the problems the world has certainly got to face is that, having got a respectable medical science and thus reduced the enormous wastage of young children which has been characteristic of the whole of human history up to the present, we have got to take some compensating steps to keep human reproduction in balance with the much reduced infantile mortality. That's where, I think, measures controlling human reproduction are going to be urgently called for, and they will have evolutionary consequences.

Glass: But these might well be general measures—one might well argue that, in general, it's undesirable for anybody to have, say, more than three children, because on the average this is all that the world can take in future.

Darlington: I should say it's very undesirable that *some* people should have three children!

Glass: Well that is the basic question, you see. There have been societies—like Nazi Germany, for example—which have said that there are certain categories of people whose further breeding should be discouraged—not only discouraged in a mild sense, but discouraged in a very positive sense, by sterilization, for example.

Darlington: Well, sterilization is practised now on a large scale in the United States and Denmark and other countries, sterilization of the mentally deficient, and I think that one cannot doubt that the population of the lunatic asylums is greatly reduced by that restriction on multiplication.

Waddington: A higher proportion of the American population is in lunatic asylums than any other population we know of.

Glass: Yes. I'm just wondering, d'you see—the mental defectives sterilized may, in many cases, in other societies be those whom you would keep in institutions, who therefore couldn't breed to any significant extent. I'm not sure whether that type of sterilization is really effective.

Darlington: I should not have thought that

was true in Denmark. I don't think their system is very different from ours.

Waddington: No, the point I was trying to make was that, if you are talking about legislative measures concerned with human reproduction, which measures are going to be difficult for a democratic society to understand and accept, I think they are going to be called for in relation to the pressure of population much more than by any attempt to direct reproduction into one channel or another. I think that there is going to be a pressure for the overall quantity of reproduction, which is going to call for steps which will be very difficult for people to swallow.

Glass: But this is non-selective?

Waddington: I feel, as Darlington pointed out, that anything that is done will be done by some general administrative mechanism. This will, in fact, be selective, but it may be done not for selective purposes—for example, say you changed the system of family allowances and cut them off after two children or did something else to try to reduce the total number of children, this would have selective consequences though it was done with an unselective aim in view.

Darlington: I suggest that the important thing is that the Government should understand the selective effects that their administrative acts are likely to have, of which they are at present entirely unaware. Whether they have any intentions in that direction it's impossible to discover.

Glass: I'm sure that they could be made more aware, or they could become more aware than they are at present. But are the experts so much more aware of the unanticipated consequences of administrative action that they could give firm guiding lines to Governments?

Waddington: You're looking at me, and I should say that the experts are not at all confident as to what the unanticipated consequences would be. I think we are confident that there will be some but we can only give guesses of what they will be. You spoke of the great advances of human genetics in Darwin's day, but you were really being rather optimistic: it's a branch of science which is remarkably little supported—there's very little work in it actually, compared to its potential importance, and I think that until we have very much further knowledge about it, we are really hardly at all in a position to give anything firm in the way of estimates of what consequences are likely to happen. But I should like to make one further, I think rather optimistic, point. In the study of animal evolution, where we are definitely dealing with genetic transmission and not social transmission, a lot of work recently has emphasized the extreme resistance of animal populations to evolutionary change. Admittedly they do evolve, but they do it jolly slowly, and anything you do to an animal population to change its hereditary make-up—you're likely to find it does something on its own to annul what you've tried to do. They have a great self-balancing property: you select all the parents which have got such and such a character—you find only about a quarter of their children will have the character, and the thing goes back to the norm.

Darlington: And the reason why human evolution is so much more rapid and so much more dangerous, and also so much more hopeful than animal evolution is, of course, that man is infinitely more diverse. Even within this one country of England, you have more human variation than you have in any species that you would call a species of any animal. And so the possibilities of selection and selective propagation within men are vastly greater, and they are going to be vastly more rapid than they can be in any animal species.

Glass: But, at the same time—aren't you anxious to encourage the persistence of variation and adaptability in man?

Waddington: Oh yes—very much so. But this point of Darlington's—it may have something in it—I think it has, but it has also a caveat—I mean, to you and me all sheep look alike, but I know a chap who is a sheep breeder, and he could look at a flock of a couple of hundred and recognize them all by their faces—by their first names. To some extent, the reason we think the human population so diverse, is that we're adjusted to spotting the differences. If you look at a whole population, say, of fruit flies, you can't tell Tom, Dick or Harry apart.

Glass: Would it be fair to say, in summing up the position, that although there have been advances since the days of Darwin, the advances have been of a kind which perhaps make some of

us rather more cautious than the people of Darwin's period would be, in that we're rather more aware of the problems which haven't been solved and the questions which need to be answered than would have been the case a hundred years ago. There are many relevant lines of work which have opened up—work which may have quite significant general social implications in the future, but we just haven't got far enough at the moment to give really firm answers to some of the questions which we believe are likely to be very important in the future.

Darlington: I think one could say a great deal more. Darwin, of course, said very little about these things. He restricted his remarks on the future of the human race to two pages, I think, at the end of the *Descent of Man.* It was Galton who talked so much about the future. But I believe we can go now a great deal further than Galton did. Although we don't know much more that is helpful in human heredity, we do know more, for example, about identical twins than Galton did. He invented the study of identical twins, and we can say with much greater confidence than he could that the conclusions he reached were right —that heredity was over-poweringly important.

Glass: Would you agree about that, Waddington?

Waddington: Well I should say the real difference this hundred years has made is this. When Darwin first wrote about it he was propounding the revolutionary idea that you could consider the future of man in terms of his genetic evolution, his evolution as an animal of a very peculiar kind. I should say, within this hundred years we have realized that was absolutely right —this is a way in which the future of man has got to be considered. We have entirely accepted Darwin's opening the door, and though we haven't got very far through the door yet, we do realize that it does open on to an enormous field of the most fundamental scientific knowledge that man can have, because it is the scientific knowledge about his own future.

Glass: Yes, I agree with that, but I should like to add a caveat from the sociological side. I think that we are only beginning to understand those aspects of the environment which are relevant to the study of heredity, and I'm thinking of this particularly in relation to what Darlington said about identical twins. We're only just beginning to understand the complexity of environmental differences between individuals and groups. There is a long way for social research to go before it can make a real contribution towards genetic research, and I don't think that without the double combination of genetics and social research we can give firm answers in either field.